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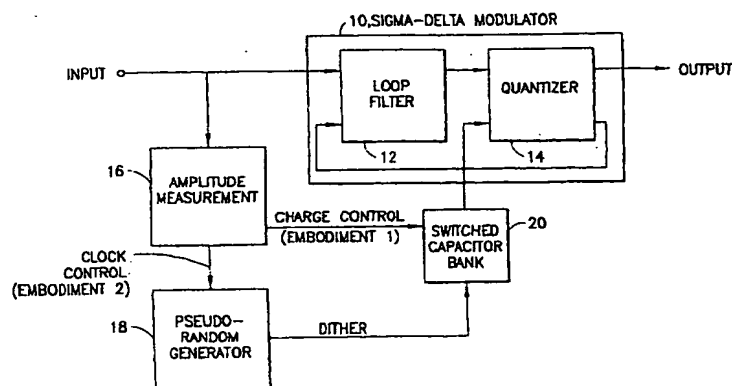
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(54) **Method and apparatus for providing signal dependent dither generator for sigma-delta A/D modulator**

(57) A method is disclosed to operate a sigma-delta modulator of a type that includes a quantizer. The method has steps of (a) sampling an amplitude of an input signal to the sigma-delta modulator; and (b) controlling the switching of a capacitance bank in accordance with the sampled amplitude of the input signal for generating a dither signal at an input of the quantizer. The dither signal is generated to have a pseudorandom amplitude that is inversely proportional to the sampled amplitude of the input signal. The step of controlling and generating operates a linear feedback shift register to switch individual ones of a plurality of capacitances of the bank of capacitances in and out of a capacitance network. In one embodiment the step of operating the at least one

linear feedback shift register turns a linear feedback shift register clock signal on and off as a function of the amplitude of the input signal. In one embodiment the step of sampling operates at least one window detector, and the dither signal is turned off and on depending on a relationship between the amplitude of the input signal and voltage thresholds of the window detector. In another embodiment the step of sampling operates a rectifier that rectifies the input signal to provide a rectified output signal, and the step of controlling and generating pseudorandomly applies the rectified output signal to the bank of capacitances for controlling an amount of current that is transferred between the input of the quantizer and the bank of capacitances.

**FIG. 1**



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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 756 384 A (AT & T CORP) 29 January 1997 (1997-01-29) * column 1 - column 11; figures 1-7 *	1-18	H03M3/02
X	S. R. NORSWORTHY: "DYNAMIC DITHERING OF DELTA-SIGMA MODULATORS" AUDIO ENGINEERING SOCIETY, October 1995 (1995-10), XP009019988 * page 1 - page 10; figure 11 *	1-18	
A	US 5 835 038 A (MURATA TOSHIO ET AL) 10 November 1998 (1998-11-10) * column 1 - column 5; figures 1-5 *	1-18	
A	GOMEZ G J: "A dynamic dither /spl Sigma//spl Delta/ ADC with 103 dB DR for audio applications" DESIGN OF MIXED-MODE INTEGRATED CIRCUITS AND APPLICATIONS, 1999. THIRD INTERNATIONAL WORKSHOP ON PUERTO VALLARTA, MEXICO 26-28 JULY 1999, PISCATAWAY, NJ, USA, IEEE, US, 26 July 1999 (1999-07-26), pages 130-133, XP010376246 ISBN: 0-7803-5588-1 * page 130 - page 133; figures 1,2 *	1-18	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H03M
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 31 October 2003	Examiner Morrish, I
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 02 25 2366

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0756384	A	29-01-1997	US 5745061 A	28-04-1998
			EP 0756384 A2	29-01-1997
			JP 9121161 A	06-05-1997

US 5835038	A	10-11-1998	NONE	

EPO FORM P0458

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